

USDA
NATURAL RESOURCES
CONSERVATION SERVICE

MARYLAND CONSERVATION
PRACTICE STANDARD

**SURFACE DRAINAGE,
MAIN OR LATERAL**

CODE 608
(Reported by Ft.)

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSE

This practice may be applied for one or more of the following purposes:

1. To dispose of excess surface or subsurface water;
2. To intercept ground water;
3. To control ground water levels;
4. To provide for leaching of saline or alkali soils.

**CONDITIONS WHERE PRACTICE
APPLIES**

This standard applies to ditches for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains. This standard does not apply to field ditches. For field ditches, refer to the Maryland conservation practice standard for Surface Drainage, Field Ditch (Code 607).

This standard provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands.

Mains or laterals having a drainage area of more than 1 square mile must meet the stability and maintenance requirements of the conservation practice standard for Open Channel (Code 582).

CONSIDERATIONS

In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping, the outlet shall provide for the disposal of the required quantity and quality of water. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

Water Quantity

1. Effects on water budget components, especially with regard to effects on runoff, soil water, and water tables;
2. Potential changes in soil moisture that will affect the growth of desirable vegetation;
3. Effect on ground water recharge;
4. Potential impacts to adjacent wetland areas.

Water Quality

1. Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses;
2. Effects on the salinity of drained soils and downstream watercourses;
3. Effects on wetlands;
4. Effect on the quality of ground water;
5. Potential for changes in downstream water temperatures;
6. Effects on downstream visual quality.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

CRITERIA

Investigations

The design and installation shall be based on adequate surveys and investigations.

Laws and Regulations

Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing waterway construction, wetlands, pollution abatement, health, and safety. The owner or operator is responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations.

Drainage Requirements

Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. Determine the degree of drainage required for crops from the Maryland Drainage Guide as expressed in terms of drainage coefficients or depth and spacing of drains.

Capacity

Provide a ditch capacity adequate for the removal of excess water, based on climatic and soil conditions and land use needs. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficient curves.

For drainage runoff determination, use the drainage curves in Chapter 14 of the Engineering Field Handbook.

Size bridges, culverts, and structures such that the design runoff will pass within bank flow. Size culverts and bridges at public road crossings to meet the minimum capacity criteria of public road authorities.

Hydraulic Gradeline

Determine the hydraulic gradeline for drainage ditch design from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary

ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 ft. below fields that will receive normal drainage from ditches draining more than 1 square mile;
2. 0.5 ft. for ditches draining 40 to 640 acres;
3. 0.3 ft. for ditches draining less than 40 acres.

For lands to be used only for water-tolerant plants, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where flow is contained by dikes.

Determine the effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section.

Channel Grade

Establish ditches on non-erosive grades with a minimum grade of 0.0005 feet per foot. Base the grades on the minimum and maximum controlling velocities specified within this standard.

Depth

Design drainage ditches deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. Base the increase on an evaluation of site conditions. Design ditches that serve as outlets for subsurface drains for normal water surface at or below the invert of the outlet end of the drain. The clearance between a drain invert and the ditch bottom shall be at least 1 ft. for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

Cross Section

Set the design ditch cross section below the design hydraulic gradeline and meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed,

allowances for initial sedimentation. Side slopes shall be stable, meet maintenance requirements, and be designed on the basis of on-site conditions.

Side slopes for trapezoidal ditches shall not be steeper than one (1) horizontal to one (1) vertical. See the Maryland Drainage Guide for recommended side slopes.

Velocity

Base the maximum permissible design velocity on site conditions and insure stability of the ditch bottom and side slopes. A desirable minimum velocity is 1.5 ft/s. On flat grades, select a channel cross section based on depth and maintenance requirements, which will result in the desirable minimum velocity if possible.

The velocity for newly constructed channels with drainage areas in excess of 1 square mile shall meet the stability requirements specified in the conservation practice standard for Open Channel (Code 582).

Maximum permissible flow velocities at either bankfull, the 10-year frequency flow, or the design capacity as determined from drainage coefficients, whichever is smallest, shall be as follows:

Soil Texture	Maximum Flow Velocity
Sand and sandy loam	2 ½ ft. per second
Silt loam	3 ft. per second
Sandy clay loam	3 ½ ft. per second
Clay loam	4 ft. per second
Clay, fine gravel graded loam to cobbles	5 ft. per second
Graded silt to cobbles	5 ½ ft. per second
Shale, hardpan and coarse gravels	6 ft. per second

Normally, the design capacity as determined from drainage coefficients will govern on the Eastern Shore whereas bankfull flow will normally govern in the Piedmont.

Capacity Design

Use Manning's Formula for determining the design velocity. Base the value of "n" on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of "n" shall be used in solving the Manning formula. These values are based on the hydraulic radius of the channel, and assuming an aged channel with good maintenance and good alignment.

Hydraulic Radius	"n"
Less than 2.5	.040 – .045
2.5 to 4.0	.035 – .040
4.1 to 5.0	.030 – .035
more than 5.0	.025 – .030

Berms and Spoil Banks

Provide adequate berms and shape, as required, for access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide work areas and facilitate spoilbank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditch banks caused by heavy loads too near the edge of the ditch banks. Provide the following minimum berm widths, except where spoil is spread according to the engineering standard for spoilbank spreading:

Ditch depth (ft.)	Minimum Berm Width (ft.)
2 – 6	8
6 – 8	10
More than 8	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes. Provisions must be made to channel water through the spoil and into the ditch without causing serious erosion.

Related Structures and Ditch Protection

Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterway, or specially graded channel entrances where surface water or shallow ditches enter deeper ditches.

Provide grade control structures, bank protection, or other suitable measures if necessary to reduce velocities and control erosion.

Size culverts and bridges with enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures generally shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

Design each structure in an open ditch system according to appropriate conservation practice standard for its intended use.

Vegetation Establishment

Stabilize the ditch bottom, side slopes and other disturbed areas in permanent vegetation according to the Maryland conservation practice standard Critical Area Planting (Code 342).

Erosion Control

Include vegetative and structural measures in the plans and specifications to minimize sediment production and transport both during construction activities and during the useful life of the channels. Measures shall include, but not necessarily be limited to the following:

1. Placing spoil in wooded areas with surface drainage away from the channel bank to minimize runoff flow over the bank. (This operation usually can be accomplished with excavating equipment.) Encourage placement of spoil to create a flow barrier when first removed from the channel section. Install surface water inlets as needed;

2. Providing and maintaining a barrier to control surface overbank flow in open areas. The barrier shall be either (a) a minimum 4-foot wide strip of dense vegetation for erosion control and bank stabilization, or (b) earth dikes or diversions discharging into controlled surface water inlets;
3. Installing sediment traps at outlets or other sensitive locations by undercutting channel bottom grade 2 feet for a distance of at least 10% of the system length above a given location. If in series, 10% applies to intervening and uncontrolled reaches;
4. Establishing protective vegetation by seeding with an appropriate plant species suitable for erosion control. If desired, select species that also provide good wildlife habitat;
5. For filtering sediments and related pollutants, use the conservation practice standard for Filter Strip (Code 393).

SPECIFICATIONS

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

Clearing

Clear and grub the area of the proposed ditch and the spoil disposal area when in cropland of all trees, roots, fences, rubbish, or other objectionable material.

Clear the spoil disposal area in woodland of all trees, brush, logs, fences, rubbish and other objectionable material. Cut trees, brush and stumps approximately level with the ground surface.

Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

The limits of the areas to be cleared will be marked by means of stakes, flags, tree markings or other suitable methods.

All materials cleared from the designated areas shall be burned, buried or piled at locations approved by the owner or otherwise disposed of as approved by the landowner.

Excavation

Excavate channels to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth.

Carry out construction activities in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent sediment pollution of water.

Spoil

Dispose of spoil in the locations and in the manner shown on the drawings or in the construction details, with tables or typical section. Grade spoil areas to provide proper drainage and left in a slightly condition.

In reaches involving realignment of existing ditches, the upstream ends of segments of the old

ditch that are cut off by the new alignment shall be filled to ground level throughout the berm area, unless otherwise specified.

Structures

Install all structures and other related protection devices as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during installation.

OPERATION AND MAINTENANCE

Establish an operation and maintenance plan to maintain the ditches installed under this standard. Maintenance needs are to be discussed with the landowner or operator who is responsible for maintaining the practices installed under this standard.

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 square mile shall be according to the conservation practice standard for Open Channel (Code 582).

Ditches shall be maintained by:

1. Keeping channels clean and free of materials that can reduce the flow;
2. Repairing eroded areas as necessary;
3. Inspecting side slopes to ensure stability is maintained. Reshape and re-seed slopes as necessary;
4. Checking outlet to ensure free flow and a stable outlet condition;
5. Controlling trees and shrubs by hand, machine, or chemicals as necessary.

**SUPPORTING DATA AND
DOCUMENTATION**

Field Data and Survey Notes

Record on appropriate MD forms and engineering paper.

1. Profile along centerline of drain at 100-foot intervals;
2. Cross sections— one per design reach not to exceed 500-foot intervals taken perpendicular to flow and extending 25 feet beyond the top of each bank;
3. Sketch of area, indicating field conditions – structures, size and location; side drainage, location and section; control points, etc;
4. Soil investigation, auger logs to determine any special construction needs;
5. Low bank at each station (if needed for critical depth);

Design Data

Record on appropriate engineering paper. For guidance on the preparation of engineering plans see chapter 5 of the EFH, Part 650. The following is a list of the minimum required design data:

1. Plan view including, job class, location map, utility notification, and construction specifications;
2. Design computations including the watershed map, drainage area, channel retardance and design velocity and discharge;
3. Plan, cross-section and profile of drain. Record design grade, bottom width, average depth, side slopes, hydraulic gradient, and berm width for each design section of new ditch(es);
4. Construction sequence to include stream channel diversion and sediment control measures;
5. Soil borings, where applicable;
6. Structures, where applicable;

7. Method of disposal;
8. Vegetative plan. This must meet the criteria, specifications, and documentation requirements of the Maryland conservation practice standard for Critical Area Planting, Code 342. Show on plan;
9. Estimated quantities;
10. Written Operation and Maintenance plan;

Construction Check Data

The following is a list of minimum data needed for As-builts. Record survey data on the drawing in red.

1. Documentation of site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom;
2. Cross sections, one per design reach;
3. Profile along bottom of completed drain at 100-foot intervals;
4. Location of spoil spreading and measurements to support special features installed;
5. Statement on seeding and fencing (if used);
6. Sign and date checknotes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards;

REFERENCES

1. Maryland Department of the Environment; *Code of Maryland Regulations; Construction of Non-Tidal Waters and Flood Plains*; www.dsd.state.md.us.
2. Maryland Department of the Environment, Water Management Administration, *Maryland's Guidelines to Waterway Construction*, May 1999;
3. Maryland Department of Transportation, State Highway Administration, *Standard Specifications for Construction Materials*, January, 2001;
4. Maryland Department of the Environment, Water Management Administration, *1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control*;
5. USDA Natural Resources Conservation Service, *National Engineering Handbook*, Part 650 Chapter 4, "Elementary Soil Engineering" and Chapter 14, "Water Management";
6. USDA, Natural Resources Conservation Service, *Maryland Field Office Technical Guide, Section IV, Standards and Specifications*;
7. USDA Natural Resources Conservation Service, *National Handbook of Conservation Practices*;
8. USDA Natural Resources Conservation Service, *Maryland Drainage Guide*.